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Physical Fitness of Correctional Officers (Prairie Region), 1977-78

University — Université

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Degree for which thesis was presented — Grade pour lequel cette thèse fut présentée

Master of Science

Year this degree conferred — Année d'obtention de ce grade

1979

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THE UNIVERSITY OF ALBERTA

PHYSICAL FITNESS OF CORRECTIONAL OFFICERS (PRAIRIE REGION) 1977-78

by

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A THESIS

SUBMITTED TO THE FACULTY OF GRADUATE STUDIES

AND RESEARCH IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF MASTER OF SCIENCE

DEPARTMENT OF PHYSICAL EDUCATION

EDMONTON, ALBERTA

FALL 1979

THE UNIVERSITY OF ALBERTA

FACULTY OF GRADUATE STUDIES AND RESEARCH

The undersigned certify that they have read, and recommend to the Faculty of Graduate Studies and Research, for acceptance, a thesis entitled Physical Fitness of Correctional Officers (Prairie Region), 1977-78 submitted by Patrick Joseph Mulgrew in partial fulfilment of the requirements for the degree of Master of Science

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ABSTRACT

Fifty-two randomly selected correctional officers and living unit officers, employed by the Canadian Corrections Service, attending a Correctional Staff College on an Induction Security Course, were given pre-programme and post-programme tests of physical fitness. The fitness programme was six weeks in duration. The major objective of this study was to assess various pre-programme and post-programme parameters of physical fitness of the officers and recommend minimum acceptable standards of physical fitness for selection and retention of officers in the Prairie Region of the Canadian Corrections Service.

The Harpenden skinfold caliper four-site technique was used to measure the body composition of the subjects. Results were expressed by weight in pounds, percent body fat, lean body weight, ideal body weight and excess weight over ideal. The Smedley Hand Grip Dynamometer was used to measure strength. Results were reported in kilograms for both the right and left hands. Estimated maximal oxygen consumption was determined with the submaximal Astrand-Ryhming Bicycle Test and the Astrand-Ryhming nomogram. Results were reported in litres of oxygen consumed per minute of exercise and millilitres of oxygen consumed per kilogram body weight per minute of exercise. Flexibility forward was measured with

the use of the Wells and Dillon Sit and Reach Box and results expressed in inches.

A one-way analysis of variance on repeated measures statistically determined significance at the .05 level for estimated maximal oxygen consumption (litres per minute and millilitres per kilogram per minute), grip strength for the right and left hands, and flexibility forward. Minimal estimated maximal oxygen consumption selection standards, suitable for age, were recommended for implementation during the hiring process as a prerequisite to the Induction Security Course. Grip strength standards were also recommended for implementation.

ACKNOWLEDGEMENTS

There are many individuals whom I wish to acknowledge and pay tribute for their assistance and cooperation toward the completion of this research:

Mr. V. H. Alward, Director, Staff College (Edmonton), for his interest in the promotion of this study.

Mr. A. J. Uhrich, Supervisor of Correctional Officer Programmes, Staff College (Edmonton), for his willingness to schedule the Staff College physical education classes at favorable times so that I could complete the requirements of this degree.

Mr. R. D. Sorenson, Instructor, Staff College (Edmonton), for his assistance during the pre-programme testing.

Dr. R. B. Swedburg, Chief, Physical Education and Recreation, National Headquarters, Ottawa, for his perseverance in obtaining the necessary research apparatus.

Dr. R. B. J. Macnab, Associate Dean, Faculty of Physical Education, University of Alberta, for his open-minded guidance in completion of this task.

Jan, my loving wife, who provided encouragement and patience during the difficult times.

And, finally, to all those correctional and living-unit officers who enthusiastically participated in this study.

Sincerely,

Patrick J. Mulgrew, B.P.E.

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INTRODUCTION

The human body must be vigorously active, and when it is not, it adjusts to the low activity level imposed and thus loses its high functional ability. Regular exercise is important in developing and maintaining an optimal level of good health, appearance, and favorable performance on and off the job. There is ample evidence indicating that being physically fit has various benefits regarding both physical and mental health (2,4,10,15,26,31,33,42).

In spite of the fact that the foregoing is well accepted on both common sense and scientific grounds, the consensus of opinion is that many people are not physically fit (1). Often, even if an individual is aware of and accepts the evidence regarding the potential benefits of becoming physically fit and wants to do so, many are not sufficiently motivated to complete the exercises necessary to achieve and maintain a favorable level of fitness.

The objective of the exercise physiologist is to assess the work demands of the individual's job and make suitable measurements necessary to evaluate the employee. Thus, Montpetit suggests:

> This knowledge is needed in selection of personnel for assignments demanding not only freedom from disease but also physiological capacity to withstand stresses of specific types.... From the psychological standpoint assessment of emotional stability, adaptability, intelligence, and motivation is equally as important as physiological capabilities in successful matching of the man and his task. (41)

Recent technological advances have almost eliminated muscular exertion in many professional and vocational fields. An unforeseen ramification has been the creation of a grossly sedentary society in which body malfunctions, including heart disease, approaches epidemic proportions. In those disciplines whose professionals are sedentary the greatest portion of the work day, and then who must react without warning into strenuous activity, the results may be disastrous in terms of job efficiency. Correctional officers and living unit officers employed by Corrections Canada serve as perfect examples of this phenomenon.

Great numbers of penitentiary employees are given desk-oriented duties as their institutional responsibilities. Such developments are a product of technological growth and increased governmental bureaucracy. Officers who are normally sedentary may be called upon to perform under physical stress during emergency situations. If one's physical capability is severely limited owing to sedentary living, possible outcomes to such a crisis may be an inability to perform effectively in spite of a willingness to do so, or a reluctance to work at maximal capacity based upon knowledge of severe self-limitations. In addition, Åstrand and Ryhming verify:

> Many times it is of interest to know the individual's capacity for muscular work, e.g. when selecting people for special tasks in military service or in industrial work, or

> when controlling the physical condition of athletes. Furthermore, a reduction of this capacity is often the first sign of disease. (5)

In research utilizing correctional officers as subjects Montpetit reports:

> A person with a high physical work capacity expends less effort for a given task, and thus has a greater reserve capacity upon which to call than the individual in poor physical condition who even under comfortable conditions performs close to the limit of his capacity. Accident records in industry support this view. Fatigue not only reduces rates but also is a contributing factor in increased absenteeism, job turnover, and poor social adjustment. (41)

This is in strong agreement with Åstrand (2), Shepard (46), and Wanzel (52).

Although many employers are aware of the need for physically fit workers (20,31), few fitness programmes have been included into the work week. The Federal Government has incorporated physical education into the Canadian Corrections Service Induction Security Training Programme located at the Staff College (Edmonton). Physical fitness is deemed to be job-related for the correctional officer. The new recruit at the Staff College (Edmonton) is required to participate in physical education four times a week for a period of six weeks. It is hoped that participation in regular, physical activity will increase the officer's awareness of the value of exercise and motivate him to continue on his own following this initial training period.

Problem

Although Pollock et al. (43) found that optimal training effects occur after many weeks training, there has been much conjecture towards the premise that effects of a short period of training will significantly alter some measurements of physical fitness. Furthermore, there appears to be concern with regard to the standards for the selection and retention of correctional officers in the Canadian Corrections Service. Thus, it would be interesting and beneficial to have specific standards for the performance and evaluation of correctional officers in the realm of physical fitness.

Limited research on physical fitness of Canadian correctional officers as a result of a training programme has been documented. Studies conducted by Montpetit (41) and McNair (38) indicated that the correctional officers did not meet acceptable levels of fitness for effective on-the-job performance.

Objectives of Research

The objectives of this research are the following:

1. assess various parameters of physical fitness of correctional and living unit officers in the Canadian Corrections Service (Prairie Region);
2. ascertain whether the Induction Security recruits meet the recommended physical fitness standards set down by Montpetit (Quebec Region), and

validated by McNair (Pacific Region) upon completion of the nine week course;

3. recommend minimum acceptable standards of physical fitness for selection and retention of officers in the Prairie Region; and
4. recommend physical fitness testing follow-up programmes for implementation within the Canadian Corrections Service (Prairie Region).

It should be noted that the organizational demand for the positions of correctional officers or living unit officers varies from time to time, institution to institution, and from one part of the country to the other. For example, it may be difficult to hire favorable-type employees in affluent parts of Canada where unemployment is low, but excellent employees may be recruited in high unemployment areas of the country. The economics of the location of the institution may, in fact, predict the calibre of the staff recruited. This factor of the employee calibre may predispose the employee's knowledge of the value of a favorable lifestyle and consequently, physical fitness.

The subjects utilized in this study were officers presently employed by the Canadian Corrections Service at the time of the study. These officers, recently hired by various institutions in the Prairie Region, were undergoing basic training at the Staff College (Edmonton).

Limitations of the Study

It is necessary to acknowledge the following limitations of this study:

1. The study was limited by the lack of available research material pertaining specifically to the physical fitness of correctional officers.

2. Another limitation was that no control group was feasible because the institutions in the Prairie Region are divided by great distances. Therefore, it was not possible to obtain representatives from each of the institutions to serve as a control.

3. Another possible limitation of this study was the assumption that the standards of physical fitness proposed for correctional officers by Montpetit were accurate, as well as his assessment of physical fitness necessary for the job.

4. The limitation that there is a great deal of difficulty in measuring skinfold adipose tissue was encountered in this study.

Definition of Terms

1. Canadian Corrections Service (Prairie Region) refers to the federal institutions located in the geographical area of Canada established as the Prairie Region.

2. Maximum Security Institution is regarded to be a federal penitentiary that houses inmates who have been classified as requiring the utmost level of security.

3. Medium Security Institution is regarded to be a federal penitentiary that houses inmates that have been classified as requiring an intermediate level of security.

4. Induction Security Training Programme refers to a nine-week course of studies in the Canadian Corrections Service located at a Correctional Staff College. This course is a pre-requisite to employment as a correctional officer or living unit officer in the Canadian Corrections Service.

5. Functional Physical Fitness for the purpose of this study refers to the ability to work effectively without undue physiological strain.

6. Norms report descriptive statistics of components of physical fitness of a particular population.

7. Standards indicate the minimum levels of physical fitness that employees would strive to reach and maintain. These levels are considered necessary for performance of a job.

8. Correctional Officer refers to an employee of the Canadian Corrections Service who serves as a custodian of inmates in a federal penitentiary.

9. Living Unit Officer refers to an employee of the Canadian Corrections Service who advises and counsels inmates and ensures security in a federal penitentiary.

10. Type III Medical refers to the Government of Canada, Health and Welfare Canada, confidential health questionnaire followed by a full clinical history and

physical examination performed by a physician, with special investigations as required.

REVIEW OF LITERATURE

Research indicates that various parameters must be measured in order to provide a reliable evaluation of physical fitness. These parameters include the following: adipose tissue, cardiovascular efficiency, muscular strength, and flexibility.

Measurement of Adipose Tissue Utilizing the Four Site Skinfold Caliper Technique

Great emphasis is presently being placed on exercise and weight control; consequently, knowledge of body composition can reveal much information regarding weight loss and weight gain. The relationship of body composition and physical activity provides meaningful information for matching man and his activity selection and participation.

The body size and shape are largely determined by skeletal size. The "ideal" body weight includes only a minimal amount of body fat (4). Since body weight may be modified to some extent by the enlargement of muscles through training, it is possible to be overweight without being obese. Generally speaking, "excess" weight, weight over and above the ideal body weight, represents accumulated body fat. Since the percentage of body weight attributable to body fat is the criterion for determining obesity, measurement of body fat is the most precise index of appropriate body weight. In addition, Yuhasz confirms:

> An adults gross body weight is really unimportant but how much fat they have is extremely important. That part of the body which is free of fat is primarily the skeleton and muscles as well as the organs and body fluids. This portion of a person's body weight is relatively stable in weight after maturation, whereas, the fat portion can change in weight quite drastically. (56)

Graphs and tables are available that present "average" weight scales for a population. This data is usually based upon height, age and sex and provides normative guidelines with regard to weight, but not excess fat. Body composition techniques provide a better guide for the determination of "ideal" weight, including the amount of adipose tissue, because of the high proportion of muscular content on the body.

The amount of lean body weight in youth as well as middle-aged men is affected by physical exercise (9). As man ages the lack of physical activity leads to a reduction of lean body weight and an increase in body fat, even though total body weight might show no marked changes.

There are several methods for a quantitative classification of body build and measurement of body fat and lean body weight. Physical educators often measure skinfold thickness in order to estimate the percentage of body fat. Body density can be estimated by means of measuring skinfold fat at various sites on the body. Several regression equations to estimate body fat from body density have been developed by different investigators utilizing a wide

variety of populations as subjects (7,8,9,23,25,26,47). These equations should be considered valid only for similar groups of individuals. The skinfold measurement can quickly be utilized in many situations, whereas, densitometry and other techniques are extremely time-consuming and special equipment is necessary (7,8,26).

Brožek and Keys (9) were among the first to use the relationship between skinfold thickness and density of the body for determination of percentage of body fat. In addition, Edwards et al. (23) selected four sites for measurement utilizing the Harpenden Skinfold Calipers which exert constant pressure at varying openings of the jaws. The width of the jaw opening is read off on a scale incorporated in the apparatus. The four sites selected were the following:

1. biceps - mid-point over the muscle with the arm resting;
2. triceps - mid-way between the olecranon and the tip of the acromion with arm hanging vertically;
3. subscapular - below the tip of the inferior angle of the scapula, at an angle of 45^{o} to the vertical; and
4. suprailiac - above the iliac crest in the mid-axilliary line.

In each measurement the skinfold was pinched up firmly between the thumb and forefinger and pulled away from the

underlying tissues before application of the calipers (21,23).

Reliability of skinfold measurements and the validity of the predicting of body density and consequently percentage of body fat are both substantial. Durnin and Rahaman (21) reported correlation coefficients for total skinfold thickness regarding four sites of the body and body density for young adult men to be -0.835. Error may occur in measurements by the manner of lifting and measuring the skinfold, thus trained personnel are necessary for the measurements (48).

To indicate the "ideal" percentage of body fat, various researchers have suggested certain criteria to be considered as "ideal". The "ideal" figures appear to be dependant upon the population selected as subjects. Brožek and Keys (9) found that in five groups of individuals aged 20.3, 25.2, 46.0, 50.0, and 54.6 years, the body density decreased steadily with age. The corresponding fat percentages calculated with the method of Rathbun and Pace (44) were 9.9, 14.4, 22.2, 24.0, and 25.2. Brožek and Keys (8) indicate an increase in fatness with age appears undesireable but a continuing rise in the relative amount of body fat is a normal phenomenon. They found a mean percentage of fat of 21.3 percent using 122 middle-aged men with a mean age of 49.0 years. The correlations of skinfolds with each other, measured at five points, varied

from +0.54 to +0.80. Brožek and Keys (8) also report a mean body fat of 10.9 percent on 133 college men aged 20.3 years. The correlations of the skinfolds with each other measured at the five locations of the body varied from +.75 to +0.94. Furthermore, Durnin and Rahaman (21) propose a mean of 13.5 percent body fat in 60 young men with a mean age of 22.0 years. In addition, Conger (12) estimates the percentage of body fat for the average young man to be 12.0 percent.

Montpetit (41), and later McNair (38), conducted research utilizing officers in the Canadian Corrections Service. Classification based on body fat determination was assessed as follows:

1. Normal - 10-15% body fat;
2. slightly overweight - 16-20% body fat;
3. overweight - 21-25% body fat; and
4. obese - >25% body fat.

These classifications were deemed suitable for officers of three age groups: 18-29 years, 30-39 years, and 40-49 years. For most purposes, a given individual is to be compared in regard to fatness with a population segment from which the individual is drawn, but for standards of body fat for correctional officers absolute values were set by Montpetit.

The Åstrand-Ryhming Physical Fitness Test for Cardiovascular Efficiency

1. Sub-maximal Workload as a Predictor of Fitness.

Glassford et al. (27) have shown that there is a direct relationship between the performance of aerobic work and oxygen consumption. In addition, Hettinger et al. (28) report that maximal oxygen consumption (MVO_2) is a reliable measure of physical fitness, when operationally defined as the capacity of the individual to endure prolonged heavy work. Physical work capacity can be determined more accurately by direct calculation, utilizing those methods of Mitchell et al. (40) and Åstrand (4,5,11). These procedures are time-consuming, require complicated laboratory procedures and demand a high degree of cooperation on the part of the subject. Åstrand (2) believes that the submaximal test can be a useful tool when applied to top athletes, trained and untrained adults. Furthermore, this is in agreement with research conducted by Ribisil and Kachadorian (45) and Wyndham (55). In such cases, the individual serves as his own control; it is a matter of comparing the individual with himself on repeated tests.

Åstrand and Ryhming (5) found that a test with a submaximal workload gives information about the physical work capacity of the subject. The best results are obtained

when the exercise is of such severity that the heart rate during steady state (4 or 5 minutes or longer after the commencement of work) is attained at a level somewhere between 120 to 170 beats per minute. Within these limits there is normally a linear increase in aerobic metabolism with heart rate (5,27). Oxygen consumption during work could be calculated from a level within a range of ± 6 percent in two-thirds of the subjects (5).

Investigations within the submaximal workload indirect test should be made during steady state. Workload and intensity should not be so high as to allow motivation to play a dominating part of the test. Work level must not be too low because psychological factors will influence body functions such as pulse rate and respiratory rate. A rough estimation of average load of work can be obtained by means of body weight (5,7,18,36).

2. The Bicycle Ergometer

Åstrand (2) and Larson (33) affirm that large muscle groups should be engaged in the work test. The oxygen transport systems can thus be exposed to stress without causing local muscular fatigue. The bicycle ergometer meets this requirement. Many researchers (37,50,51) indicate that the mechanical efficiency of the subject's cycling is high, given an appropriate workload. Furthermore, the workload can be carefully determined and is reproducible.

Wahlund (51) reveals the advantages of the bicycle ergometer when used in tests of physical work capacity. The ergometer is small, portable and can be used in large population studies. Volume of oxygen consumption is directly related to workload; therefore, one can make comparisons of individuals from workload to workload. Determinations of various physiological parameters are measured easily during work. Research conducted by von Döbeln (50) and the literature of Matthews and Fox (36) support the above. Furthermore, the bicycle ergometer is safe and easy to operate for almost any individual, and running costs are low (33). Shephard (46) adds that the researcher must be aware of the need to ensure that the brake belt remains at a constant workload as the subject rides the bicycle.

3. Åstrand-Ryhming Nomogram

Åstrand and Ryhming (5) report that the heart rate for a group of male subjects averaged 128 beats per minute after six minutes of work when the demand for oxygen is fifty percent of the maximal oxygen intake of the individual. Maximal oxygen consumed per kilogram body weight (ml/kg. per min.) provides a good index of physical fitness (5,11,36). The Åstrand-Ryhming nomogram (3) produces a good estimation of maximal oxygen uptake in a population unaccustomed to cycling. This nomogram is presented where the maximal oxygen consumption of an individual can be calculated from heart

rate and oxygen consumption (or work level) reached during a test with a submaximal rate of work. The nomogram is based on results from experiments with healthy subjects 18-30 years of age (5).

Statistical analysis of correlation coefficients between the Åstrand-Ryhming nomogram and other maximal oxygen uptake tests indicated a high correlation (27).

Based on the findings in their experiments, Åstrand and Ryhming (5) developed values which have been included in the nomogram work levels. The work load setting for men is 1200 kilopond metres per minute (kpm. per min.) when MVO_2 is measured. A comparison of predicted and observed MVO_2 measurements gives a mean difference of .023 ± .059 litres of oxygen for men. With a lower work load of 900 kpm. per min., the standard deviation is higher for men.

Later studies by Åstrand (3,4) extended the nomogram to include a total of 129 male subjects in the age range of 20-69 years. An age correction factor was established with the use of the original nomogram. Åstrand explains that when the age range is increased, the error in prediction rises from the previously reported ± 6.7% to ± 10% (2,3).

DeVries and Klafs (19) affirm that the Åstrand-Ryhming nomogram prediction in 16 males majoring in physical education, aged 20-26 years shows a correlation of .736

with various other measures of maximal oxygen consumption. The standard error of prediction for the Åstrand-Ryhming nomogram is found to be ± .359 litres per minute when the prediction was made from heart rate measures alone under a work load of 900 kpm. per min. From this study, in active college men, MVO_2 and consequently physical work capacity can be predicted with a reasonable error from a submaximal test.

Hettinger et al. (28) report the correlation between predicted and measured MVO_2 to be statistically significant at the .01 level. Furthermore, Teraslinna and Ismail (49) report a correlation coefficient of .92 between the Åstrand nomogram prediction and actual measured values for maximum oxygen uptake.

Measurement of Grip Strength Utilizing the Hand Grip Dynamometer

Muscular strength is defined as the capacity of a muscle group to exert maximal force against a resistance. Most often, strength is measured in a static condition when muscles develop tension against a resistance. Strength can be measured in units of pounds or kilograms utilizing various dynamometers. The hand grip dynamometer is preferred by most experts because the difference in loading is not great and the test is reliable from age six upward (33). In addition, Shepard admits:

> An assessment of strength should include representative testing of the arm, leg and back muscles. However, the majority of the authors have been content to measure grip strength, using some form of dynamometer. (46)

The Smedley Hand Grip Dynamometer (29) is an instrument utilized for scientific measurement of muscular strength of the hand and forearm. Facilities are provided to adjust the grip span in order to meet the various individual hand requirements. The large dial and long pointers, combined with a heat treated and calibrated spring, provide an instrument of high accuracy.

Montpetit (41), and later McNair (38), measured the grip strength of correctional officers utilizing this instrument. It was determined by both researchers that leg and back strength was necessary for efficient correctional work. However, the leg and back dynamometer was felt to be impractical in their research. The hand grip dynamometer was used in both aforementioned studies because of the fair correlation between leg and back strength and grip strength (38).

The Canadian Association for Health, Physical Education and Recreation (39) completed a national survey utilizing the Smedley Hand Grip Dynamometer as a tool for measurement of grip strength. The results of this study appear in Appendix A. In the range of 18-44 years, there does not seem to be a decrease of grip strength with age.

The Wells and Dillon Sit and Reach Board as a Measurement of Flexibility Forward

Flexibility is the ability to use a muscle throughout its full range of motion and is most often associated with movement in the joints of the body. Physiological characteristics influencing the extensibility of the muscles and ligaments surrounding a joint determine the flexibility of an individual (7). The need for flexibility varies with the work tasks to be performed. Considerable evidence indicates that good flexibility relieves aches and pains that become common with increasing age (18).

Precise calculation of flexibility of various muscle groups may be determined with the use of the Leighton Flexometer (34), but it was decided that this information may be too specific for the present needs of the Canadian Corrections Service.

Forward flexibility appears to be the most consistent measure of flexibility found in the literature (16,33). The International Committee for the Standardization of Physical Fitness Tests suggests: "The flexion of the trunk is chosen as the test for flexibility because this movement is one of greatest importance in human motion." (33) Physical educators most often utilize the sit and reach test to evaluate forward flexibility of the trunk, back, and posterior muscle groups of the legs (18,53). The Wells

and Dillon sit and reach test has been widely used by practitioners. The sit and reach test is highly reliable, as a coefficient of correlations of 0.98 has been reported (53).

Research into Employee Physical Fitness in the Canadian Corrections Service

Research into physical fitness of the correctional officer in the Canadian Corrections Service has revealed two studies. In 1974, Montpetit (41) assessed the physical work capacity of correctional officers, measured the degree of physiological strain on the job, and recommended standards of fitness for this occupation. This research was conducted in the Quebec Region. McNair (38), in 1976, utilized correctional officers in the Pacific Region for an evaluation of physical fitness. McNair assessed the physical fitness levels of correctional officers, determined the effectiveness of the fitness training portion of the Induction Security course, and ascertained whether the recruits met the recommended standards of physical fitness set down by Montpetit for correctional officers in the Canadian Corrections Service.

In order to assess the physiological responses of officers to environmental stresses during actual performance of the job, Montpetit had three officers wear a small portable ECG amplifier and tape recorder during tasks representative of the various functions fulfilled by

correctional officers in an eight-hour day. Additional information about the degree of physical activity during the work day of an officer was obtained by having 172 officers answer a special questionnaire. Also, sufficient information was available to estimate the energy expenditure of a correctional officer during the eight-hour period. This was obtained from a description of the different tasks fulfilled by officers and approximate time spent on these tasks.

The type of metabolic pattern seen during a typical work day of a correctional officer is illustrated in Appendix B. Montpetit did not expect any officer to reach a pulse greater than 130 beats per minute under ordinary circumstances. Based on published data for energy expenditure of various activities, Montpetit computed approximate energy output for an eight-hour work day. Energy expenditure outside work was also estimated.

Montpetit reports that during their daily work tasks, officers exhibited heart rates that were comparable with those of sedentary jobs. Montpetit's actual observations and evaluation of the physical activity questionnaires suggested that a pulse rate exceeding 115 beats per minute is relatively uncommon in the daily work of a correctional officer. Montpetit assumed that outside their work activities the pulse of a typical correctional officer does not reach a much higher level of intensity, since less than one percent reported that they participated regularly in physical

exercise and/or games. Montpetit concluded that an excess of caloric intake along with a minimal amount of physical activity account for the great percentage of overweight officers.

As a result of the questionnaires, Montpetit collected some information on the drinking and smoking habits of the officers. Results indicated that almost 40 percent of all officers are non-drinkers. The percentage of officers who smoke was almost 70 percent.

In each of the studies conducted in the Canadian Corrections Service, three indicators of physical work capacity were measured: body composition, cardiovascular fitness, and muscular strength. All of the means of the groups tested by Montpetit (41) were greater than the "ideal" weights calculated by skinfold thickness. "Ideal" weight was calculated in this study when the subject had less than 15.0 percent body fat. It was found that 73.4 percent of the officers were overweight and 45.2 percent were considered obese. McNair (38) revealed that 89.6 percent of the correctional officers tested were overweight and 20.63 percent were considered obese. Calculations were based upon skinfold thickness.

Cardiovascular efficiency, that is, the ability of the body to consume oxygen, is deemed the most effective indicator of physical fitness (5,15,22,28,30,31,33,37,45). Montpetit determined that only 7 percent of the total

population of correctional officers tested could be classified as fit (41). McNair concluded that 76 percent of the correctional officers tested failed to measure up to their civilian counterparts. The 40-49 year age group were the only officers to remain on par with Canadian national norms in cardiovascular fitness (6,38).

Muscular strength, another indicator of physical work capacity, was measured by Montpetit. Grip strength of the correctional officers was higher than the Canadian norm except in the 40-49 year age group (41). McNair found that those officers in the 18-29 year age group exceeded the Canadian norm, but subjects in the 30-39 and 40-49 year age group fell short of the Canadian norm (38).

Montpetit recommended minimum physical fitness and body composition standards for correctional officers on the premise that "below this minimum level, health, work capacity and productivity are adversely affected." (41) Montpetit's criteria for minimal levels of fitness for the correctional officer in the Canadian Corrections Service were the following:

1. Skinfolds less than 45 m.m.distributed over four sites. The sum of the skinfold measures is an accurate index of the amount of fatness. A skinfold measurement of 45 m.m. indicates that the officer will be less than 10 pounds over the average 20-29 year old officer of his body build.

2. Maximal oxygen consumption value according to age:
   (a) 20-29 years - 38 ml/kg. per min.
   (b) 30-39 years - 35 ml/kg. per min.
   (c) 40-49 years - 31 ml/kg. per min.
3. Grip strength more than 47 kilograms on the hand grip dynamometer (41).

McNair reported that a comparison of pre-test and post-test data conducted on officers who attended the summer Induction Security course (Pacific Region), indicated a significant positive change in estimated maximal oxygen consumption. A decrease in mean scores was noted in grip strength.

When Montpetit's standards of fitness were compared with results achieved by officers after the nine-week Induction Security course, it was found that 35.7 percent of those tested in the Pacific Region failed to meet minimum recommended body composition standards. It was also determined that 64 percent of the group met the recommended minimum standard for maximal oxygen consumption and grip strength (38).

METHODOLOGY

In this study the variables and research tools were the same as those employed by Montpetit (41) or McNair (38). This was deemed crucial since one objective of this study was to ascertain whether the Induction Security recruits meet the recommended physical fitness standards set down by Montpetit. The standards of physical fitness were later validated in the Canadian Corrections Service (Pacific Region) by McNair.

The Sample

The sample consisted of fifty-four penitentiary officers aged 18-49 years employed by the Canadian Corrections Service. Forty-nine of these employees were classified as correctional officers (CX-COF), while five were classified as living-unit officers (CX-LUF). Fifty-two of the officers completed both the pre-test and post-test situations. One officer did not complete the post-test because of his resignation from the Service during training, while the other officer was ill on the scheduled post-test date. The pre-test results of these two officers were not utilized in this study. Both officers were classified as correctional officers.

The individuals included in this study were selected at random. Four of the five Induction Security classes at the college during the testing portion of the study were selected as subjects. The subjects utilized for the study

were in the following Induction Security classes: 34122/1/6/77/542, 34122/1/7/77/542, 34122/1/1/78/542, and 34122/1/3/78/542. Induction Security class 34122/1/2/78/542 was not selected for this study because of the workload of the researcher at the time of the study. This class was omitted from the study prior to the class arrival at the Staff College (Edmonton).

The major duties of the correctional officer are the following: maintaining surveillance over and controlling movement activities of inmates; controlling vehicles and pedestrian movement inside and outside the institution; operating base and station radio and telephone switchboard; performing escort duty; enforcing safety and security measures; making scheduled and unscheduled patrols; counting and searching inmates; and other related duties.

The primary duties of the living-unit officer include: participation as an active member of a living-unit team that directs itself towards the correctional influence of inmates by establishing effective relations with the inmates, providing advice to inmates, assessing and reporting on the progress of inmates, maintaining control and supervision of inmates and the security of the institution; maintaining active liaison with other staff members to exchange information relating to inmate progress; and performing other related duties.

Upon completion of the Induction Security Training

Programme, the officers will execute the aforementioned duties in the various institutions in the Prairie Region.

The sample of officers employed by institutions of two "security levels" were obtained for the purpose of this study. Thirty-nine officers who participated as subjects in this research began their employment in "maximum security" institutions, while thirteen commenced work in "medium security" institutions. The fifty-two officers were recently hired prior to their arrival for training at the Staff College (Edmonton) in the Induction Security course. Subjects in this study were employed at the following institutions in the Prairie Region: Saskatchewan Penitentiary, Stony Mountain Institution, Edmonton Institution, Bowden Institution, and Drumheller Institution.

1. Pre-Programme Measurement

All fifty-two of the pre-programme sample completed the total testing format. The physical fitness tests were administered on the following dates:

GROUP	NUMBER TESTED	DATE
A	10	Oct. 24, 1977
B	16	Oct. 25, 1977
C	10	Jan. 16, 1978
D	16	Feb. 13, 1978
TOTAL	52	

2. Fitness Programme

As a requirement of their Induction Security Training Programme, the officers completed a physical education course that consisted of 28 fifty minute sessions. The officers participated in 4 sessions per week for a period of 6 weeks. Four sessions were utilized in the 6 week period for lectures and films. The objectives of the course were as follows:

(a) teach the candidate officer methods of obtaining and maintaining a high standard of physical fitness;

(b) expose the candidate officer to the basic physiology of physical training and the benefits of exercise;

(c) assist the course member to prepare both physically and mentally for institutional employment;

(d) develop teamwork, leadership and sportsmanship skills; and

(e) expose the candidate officer to beneficial and enjoyable uses of leisure time.

Each class period consisted of a warm-up period for approximately five minutes. Exercises that were utilized in the warm-up included: slow jogging, stride jumps, arm swings, neck rotations and trunk rotations.

Following the warm-up, approximately ten minutes was spent on flexibility exercises. The flexibility exercises employed included the following: toe touches, heel stretch,

quadraceps stretch, groin stretch, hamstring stretch, single and double leg raises, knee pulls, inverted bicycle, plough, trunk extension, and shoulder stretch.

The cardiovascular endurance aspect of the programme included twelve to fifteen minutes minimum of jogging, snowshoeing, soccer, floor hockey, team handball, or basketball. Students were advised to maintain a training heart rate of 70 to 80 percent of their predicted maximum heart rate.

Muscular strength and muscular endurance exercises were often done in conjunction with the cardiovascular endurance component of the programme, as in the case of circuit training. Exercises included: push-ups, sit-ups, lateral leg raises, star jumps, half knee bends, heel raises, squat thrusts, and the sprinter's run. Students were given the opportunity to utilize the Universal Gymnasium in class time for a twenty-minute period once per week. Approximately ten minutes per session was devoted to muscular strength and muscular endurance training.

The final aspect of the programme was a five minute cool-down period where the students were instructed to walk and participate in light calisthenic and stretching exercises.

3. Post-Programme Measurement

Fifty-one officers completed the post-programme physical fitness testing in its entirety. One officer expressed discomfort during the Åstrand submaximal test after approximately two minutes of testing. Consequently, the test was halted. The officer was advised to seek a thorough medical evaluation by a physician. The following depicts the administration of the post-programme testing:

GROUP	NUMBER TESTED	DATE
A	10	Dec. 5, 1977
B	16	Dec. 6, 1977
C	10	Feb. 27, 1978
D	16	Mar. 28,29, 1978
TOTAL	52	

Procedure

1. Pre-Programme Test

During the hiring process each officer in the CX-COF and CX-LUF categories is given a Class III Medical Examination by a physician. This takes place prior to his arrival for training at the Staff College (Edmonton). It has been determined by the Federal Government that the Class III Medical Examination is suitable for the officer in order to meet the training expectations and job requirements.

Prior to actual testing, the subjects were instructed

on testing procedures and requirements, as well as the objectives of the research. In an attempt to avoid any influence on heart rate and other factors, all subjects were instructed not to take drugs on the day of the test, to refrain from food for at least two hours before the test, to refrain from smoking for an hour prior to the test, and to avoid any unnecessary exercise on the day of the test. To get a good measure of cardiovascular efficiency and other measurements, anxiety was kept to a minimum by ensuring the laboratory to be quiet, and providing the necessary verbal reassurance before and during the tests.

All officers who participated in this study underwent the pre-programme physical fitness tests which included the following:

(a) Height:

Height was measured with a Detecto-Medic scale and values taken (without shoes) in inches.

(b) Weight:

Weight was measured with a balanced Detecto-Medic scale and values taken in kilograms. Kilograms were later converted into pounds.

(c) Grip Strength:

Grip strength was measured with a Smedley Hand Grip Dynamometer. The distance from where the subject's thumb joins the hand to the end of the fingers was measured with a millimeter rule. The

dynamometer was adjusted until the scale of the outer stirrup indicated one-half this distance. Upon request of the subject, the stirrup was changed to meet his inclinations. The clutch was then placed in position so that the stirrup would not twist. The subject was instructed to hold the hand grip dynamometer in a pronated position with his arm extended directly over his head. He was then instructed to squeeze the dynamometer while bringing his arm laterally downward without touching his torso. It was made clear to the subject that the lower pointer would measure the score, so there was no need to maintain the grip while the score was being read. The subject was allowed three trials with each hand, right and left alternately, with a brief pause between each effort. Measurements were taken in kilograms, and the mean score was recorded with each hand.

(d) Skinfold Measurements:

Skinfolds were taken at four sites on the anatomy in millimeters using the Harpenden Skinfold Calipers. The skinfolds were lifted by the researcher using his index finger and thumb, allowing the skinfold to follow its natural stress lines as it was lifted. All measurements were made on the right side of the body. The calipers were

applied about one centimeter from the fingers and where the two surfaces of the fold were parallel. Three measurements were taken on each site and the mean score was recorded for each site. Readings were recorded to the nearest tenth of a millimeter. The following sites were utilized for measurement:

(i) Triceps - skinfold was located over the triceps muscle at the mid-way point between the acromion and olecranon processes; the crest of the skinfold being parallel to the long axis of the upper arm.

(ii) Biceps - skinfold was located over the biceps muscle at the level halfway between the acromion olecranon processes; the crest of the skinfold being parallel to the long axis of the upper arm.

(iii) Subscapular - skinfold was measured approximately one centimeter below the inferior angle of the scapula; the crest of the skinfold being radically upward and laterally downward at about 45^{o}.

(iv) Suprailiac - skinfold measurement took place about three centimeters above the iliac crest with the skinfold lifted horizontally.

These four skinfold thicknesses were totalled, body density and percentage of body fat were calculated using Durnin's formula (21). Fat

weight, lean body weight, and ideal body weight were then calculated. The criteria that was utilized as the ideal percentage of body fat has been determined to be 15.0 percent based upon the literature of: Durnin and Rahaman (21), Brožek and Keys (8,9), Montpetit (41), McNair (38), Baumgartner and Jackson (7), Getchell (26), and Sloan and Weir (47). An increase in the percentage of body fat is undesireable with age even though a continual rise in the percentage of body fat is considered a normal phenomenon (8,9).

(e) Estimated Maximal Oxygen Consumption (MVO_2):
In tests which require submaximal efforts such as the Åstrand-Ryhming Bicycle Test, factors such as motivation of the subject, criteria for exhaustion, level of physical fitness of the subject and individual variations in mechanical skill will not play such an important role. Consequently, Åstrand's single stage bicycle test was used to predict oxygen consumption.

Submaximal exercise was performed on a mechanically braked, calibrated Monark bicycle ergometer where the seat height was adjusted to a comfortable riding position. While the subject relaxed, the P-2 Cardiometer and appropriate leads were secured. The Cardiometer P-2 is a heart rate

meter specifically designed for physical fitness measurement on the bicycle ergometer. This instrument monitors action current from the heart, makes an analysis to find out the R-tags, calculates the mean heart rate value from R-R intervals and presents the heart rate per minute on a wide angle scale. Each single heart rate value is indicated from 40 to 220.

The subject was instructed to pedal at a speed of 50 revolutions per minute. A metronome was utilized to aid the subject in maintenance of the correct speed. After two minutes of pedalling (warm-up), the subject was given a workload (measured in kilopond meters) to suit his size, age, and expected fitness level. The two minute warm-up allowance in this study is different from the originally proposed Åstrand-Rhyming test. It was decided to provide the warm-up period to follow those procedures of McNair. The subject was instructed to continue pedalling at 50 revolutions per minute for 6 minutes or until exhaustion. Heart rates were taken in the last five seconds of each minute for six minutes. If the participant's heart rate did not reach 120 beats per minute after the first two minutes the load was increased. After six minutes of continuous testing at a given load,

providing the last two heart rates were within five beats, the test was discontinued. The mean value of the fifth and sixth minute heart rate was designated as the working pulse. The subject then continued pedalling for another minute without load in order to "cool down". Predictions of maximal oxygen consumption from heart rates and work loads were calculated from the Åstrand-Ryhming nomogram with the appropriate correction made for age (4).

(f) Flexibility Forward:

The subject assumes a sitting position with his legs fully extended. His feet are placed against the crossboard. The subject then is instructed to reach forward, palms down and both hands even, and push the block along the scale until the maximal point is reached and held for 2 seconds. The fingertips of both hands must remain in constant contact with the block. Two trials are taken in centimeters (nearest tenth of a centimeter) and the mean score is computed in inches.

2. Post-Programme Test

Post-testing procedures were identical in form to those utilized in the pre-test situation, with the exception that height was not measured in the post-test. The same apparatus was utilized and efforts were made to schedule

post-programme tests at or near the same time of day as the pre-programme tests.

3. Statistical Procedures

Raw data from the pre-programme and post-programme physical fitness measurements of penitentiary officers was collected and calculated. Means and standard deviations were computed for each parameter in both the pre-programme and post-programme. A pre-programme and post-programme one-way analysis of variance was calculated with the aid of a computer at the University of Alberta. The one-way ANOVA was used to test hypotheses concerning population means. The between groups variance estimate was determined.

A one-way ANOVA on Repeated Measures was utilized to determine statistical significance of the physical fitness measurements of penitentiary officers from the pre-programme test to the post-programme testing situation.

The following parameters were statistically analyzed:

1. Age
2. Weight
3. Percent Body Fat
4. Lean Body Weight
5. Ideal Body Weight
6. Excess Pounds Over Ideal Weight
7. Estimated Maximal Oxygen Consumption (litres per min.)

8. Estimated Maximal Oxygen Consumption (ml/kg. per min.)

9. Flexibility Forward

10. Grip Strength - Right Hand and Left Hand

The level of significance was set at the .05 level. This level was selected to remain consistent with the work of McNair (38).

RESULTS AND DISCUSSION

The results of this study are presented under four major headings. The first section, Pre-Programme Physical Fitness Levels of Penitentiary Officers (Prairie Region), displays data on the physical fitness of the officers upon their arrival at the Staff College (Edmonton) for induction training. The second subdivision outlines the Post-Programme Physical Fitness Levels of Penitentiary Officers in the Prairie Region. The third heading, Effectiveness of Physical Education in the Induction Security Programme, compares the pre-programme and post-programme mean values of physical fitness. Finally, the Post-Test Results of Physical Fitness Mean Values for Penitentiary Officers Compared with Montpetit's Recommended Standards are brought forward.

Pre-Programme Physical Fitness Levels of Penitentiary Officers (Prairie Region)

Pre-test data was collected and calculated. Means, standard deviations and a one-way analysis of variance were calculated with the aid of a computer. The one-way ANOVA was used to test hypotheses concerning population means. The between groups variance estimate and the within groups variance estimate were determined. Based on observations made on samples, generalizations were made to the populations they represent. The results for three levels of age were tabulated and appear in Table 1 and Table 2. These three levels of age were utilized to maintain consistency with

Table 1: Pre-Programme Body Size and Body Composition of Penitentiary Officers in the Prairie Region (Means, Standard Deviations, and Ranges)

	Groups	18-29 years	30-39 years	40-49 years
	Number of Subjects	32	10	10
	Age - years	23.7 ± 2.7	34.4 ± 3.3	42.7 ± 3.1
	Height - inches	70.5 ± 2.6 66.0 - 77.5	69.5 ± 2.5 64.0 - 72.5	69.7 ± 2.1 67.0 - 73.0
*	Weight - pounds	178.2 ± 25.6 134.3-232.8	184.0 ± 26.9 141.0-224.0	179.8 ± 23.9 137.3-224.4
*	Body Fat - percent	24.7 ± 4.7 13.5 - 31.6	25.7 ± 4.6 18.6 - 35.5	25.4 ± 4.1 17.6 - 30.7
*	Lean Body Weight - pounds	133.5 ± 15.3 107.7-168.1	136.4 ± 18.4 102.5-166.0	133.5 ± 13.9 111.2-159.8
*	Ideal Weight - pounds	151.5 ± 21.7 127.8-202.4	156.4 ± 22.8 123.7-198.8	152.8 ± 20.3 133.7-193.4
*	Excess Weight Over Ideal - pounds	18.0 ± 10.0 -2.5 - 34.2	20.0 ± 10.8 3.0 - 45.9	19.4 ± 8.8 3.6 - 28.4

* Calculated from skinfolds.

Table 2: Pre-Programme Physical Fitness Levels of Penitentiary Officers in the Prairie Region (Means and Standard Deviations)

	Groups	18-29 years n=32	30-39 years n=10	40-49 years n=10
*	Estimated MVO_2 - litres per min.	3.2 ± .5	2.9 ± .6	2.4 ± .3
*	Estimated MVO_2 - ml/kg. per min.	39.8 ± 6.7	34.9 ± 8.2	29.6 ± 5.7
*	Grip Strength Right Hand - kg.	59.6 ± 9.1	53.3 ± 6.2	49.4 ± 7.5
*	Grip Strength Left Hand - kg.	55.0 ± 7.4	53.2 ± 6.9	48.3 ± 8.0
*	Flexibility Forward - inches	11.7 ± 3.4	13.3 ± 1.6	8.4 ± 3.8

* Pre-Programme ANOVA Between Groups significant at the .05 level.

other physical fitness studies conducted with correctional officers.

1. Body Size and Composition

The concept of "ideal" weight is related to the percentage of body fat. Excess weight represents accumulated body fat. Measurement of body tissue is a much better guide for determining ideal weight than the various tables available that are based upon physique and height. As reported in the Review of Literature, there is much controversy in regard to the ideal percentage of body fat. Researchers agree that the ideal percentage of body fat for the normal male less than 30 years should be approximately 15.0 percent.

The body size and composition of the officers tested appear in Table 1. Officers in the 30-39 year age group are heavier but slightly shorter than the other two age groups. The officers tested in this study, aged 18-29 years, had a mean percentage of body fat of 24.7 percent, much higher than the ideal of 15.0 percent. If the ideal percentage of body fat is to remain constant at 15.0 percent for all males, regardless of age, the 30-39 year age group (25.7%) and the 40-49-year age group (25.4%), also rate poorly when compared to the "ideal". It is felt that age should not be a factor with regard to an increase in the percentage of body fat (8), and hence, the percentage of ideal body fat was determined to be 15.0 percent for all age groups. Calculations were based upon the work of

Yuhasz (56) and Durnin and Rahaman (21).

A comparison between the body site measurement results obtained for adipose tissue in this study can be compared to the national study published by the Canadian Association for Health, Physical Education and Recreation (39). The C.A.H.P.E.R. study utilized sample units in the following age groups for men: 18-29, 20-24, 25-34, and 35-44 years of age. In this study three age groups were selected: 18-29, 30-39, and 40-49 years of age. Since the mean age in the 18-29 year old group in this study was 23.7, it is possible to compare this unit with the 20-24 year old C.A.H.P.E.R. norms. Also, the mean age in the 30-39 year old group in this study was 34.4, therefore, a comparison may be made with the 25-34 year old C.A.H.P.E.R. norms. Finally, since the mean age in the 40-49 year old group in this study was 42.7, a comparison may be made with the 35-44 year old C.A.H.P.E.R. norms.

The C.A.H.P.E.R. study utilized four body sites for skinfold measurement: subscapula, triceps (posterior aspect of left arm), abdomen, and hip (left supra-iliac). Three of these four sites were utilized in this study, but all measurements took place on the right side of the body.

In this study the mean subscapula measurement in millimeters of adipose tissue for the 18-29, 30-39, and 40-49 age groups was 23.7, 25.2, and 25.2 respectively. When compared to the C.A.H.P.E.R. subscapula norms, the

mean values for all three age groups in this study were at the 95th percentile. The range of scores for the 18-29 year old group was from 8.9 - 42.8 millimeters of body fat. The C.A.H.P.E.R. norms for this age group indicate a range from the 30th percentile to the 100th percentile. The range of scores for the 30-39 year old group was from 12.2 - 47.1 millimeters of adipose tissue. A range from the 45th percentile to the 100th percentile was indicated on the C.A.H.P.E.R. norms for this group. The range of scores for the 40-49 year old group was from 10.1 - 42.2 millimeters of body fat. For this age group, the range on the C.A.H.P.E.R. norms was from the 15th percentile to the 100th percentile.

The mean triceps measurement value in millimeters of adipose tissue in this study was 17.4, 17.4, and 16.8 for the 18-29, 30-39, and 40-49 year old age groups respectively. The C.A.H.P.E.R. norms for triceps measurement showed that the mean values of the 18-29, 30-39, and 40-49 year old groups were at the 100th, 95th, and 95th percentiles, respectively. Review of the range of individual data for triceps measurement showed the 18-29 year old group to be 9.3 - 31.4 millimeters of adipose tissue. The C.A.H.P.E.R. norms for triceps measurement of body fat show a consequent range from the 70th to the 100th percentile. The range of individual triceps measurement of body fat for the 30-39 year old group was from 10.1 - 36.7, which were expressed

to be from the 60th to the 100th percentile on the C.A.H.P.E.R. norms. The 40-49 year old age group had a range of 9.3 - 20.9 millimeters of body fat measurements on the triceps measurement site. The C.A.H.P.E.R. norms expressed a range from the 55th to the 95th percentile for this age group.

In this study, the mean suprailiac measurement in millimeters of body fat was 30.7, 31.8, and 31.6 for the 18-29, 30-39, and 40-49 year old groups respectively. The C.A.H.P.E.R. norms for suprailiac measurement showed that each age group's mean scores in this study were at the 95th percentile. The 18-29 year old group ranged from 10.6 - 49.1 millimeters of body fat, which ranged from the 55th to the 100th percentile on the C.A.H.P.E.R. norms. The 30-39 year old group ranged from 15.9 - 53.3 millimeters of adipose tissue, which were indicated to be from the 55th to the 100th percentile on the C.A.H.P.E.R. norms. The 40-49 year old group range was from 18.9 - 50.4 millimeters of body fat. The C.A.H.P.E.R. norms showed a range from the 70th percentile to the 100th percentile.

Results indicate that excess over ideal weight support the fact that the mean of the officers tested were over-weight. In each age group the officers exceeded the ideal weight as follows: 18-29 years (18.0 pounds), 30-39 years (20.0 pounds), and 40-49 years (19.4 pounds).

Table 3 shows officers within the normal range comprise only 2.9 percent of the sample tested, while those over-

weight or obese constitute 76.5 percent. When this data is compared to that of the Quebec and Pacific Regions in the Canadian Corrections Service, a definite national trend of "overweightedness" appears in the mean officers tested, whether the employee was a newly recruited officer or one that was in the Service for some time.

Table 3: Pre-Programme Percentage of Officers With Normal and Excess Weight

Age of Officers (Prairie Region)	Normal (i)	Slightly Overweight (ii)	Overweight (iii)	Grossly Overweight (iv)
18-29 yrs. n=32	2.9	20.6	14.7	61.8
30-39 yrs. n=10	0	10.0	30.0	60.0
40-49 yrs. n=10	0	20.0	10.0	70.0
TOTALS OF REGIONS:				
Prairie Region n=52	1.9	18.5	16.7	63.0
Pacific Region (38)	10.4	37.5	31.5	20.6
Quebec Region (41)	9.4	17.1	28.1	45.3

(i) < 15.1% Body Fat

(ii) 15.1 - 20.0% Body Fat

(iii) 20.1 - 25.0% Body Fat

(iv) > 25.0% Body Fat

2. Estimated Maximal Oxygen Consumption (MVO_2)

Maximal oxygen consumption refers to the volume of oxygen that can be taken and transported by the cardiovascular system as well as the efficiency with which the muscles utilize the oxygen supplied to them in order to mobilize energy (38). Cardiovascular fitness, then, represents the efficiency of the heart, lungs, and blood vessels, and consequently, the most important measure of total fitness.

The pre-programme mean estimated MVO_2 values of officers tested in the Prairie Region are given in Table 4. The estimated maximal oxygen consumption values of litres per min. and ml/kg. per min. tend to decrease with age.

Table 4: Estimated Maximal Oxygen Consumption Pre-Programme Mean Values for Officers in the Prairie Region

AGE	Estimated MVO_2	
	litres per min.	ml/kg. per min.
18-29 years n=32	3.2	39.8
30-39 years n=10	2.9	34.9
40-40 years n=10	2.4	29.6

Table 5 indicates that the mean pre-programme estimated MVO_2 scores in every age group surpassed the Canadian norms (6). A comparison of correctional officers from the Quebec and Pacific Regions reveals that officers in the Prairie Region have greater estimated pre-programme maximal oxygen consumption values. The differences may be the result of including living-unit officers into the sample in the Prairie Region. Close observation of the fitness test results of the living-unit officers included in this study indicated higher MVO_2 values. The estimated maximal oxygen consumption values of officers in the Canadian Corrections Service (Prairie Region) study may have been greater because they had recently been hired and had not been exposed to the potentially stressful institutional environment. Also, the influence of "Participaction" and a general awareness of fitness may have positively influenced the general public, including penitentiary employees, the last few years.

A comparison in Table 6 is made among mean estimated MVO_2 values achieved by penitentiary officers in the Prairie Region, American Heart Association Recommended Norms - Average Category (6), and the fitness standards for cardiovascular efficiency recommended for correctional officers by Montpetit as a result of the Quebec Region study (41). The mean MVO_2 scores for pre-programme penitentiary officers tested in the Prairie Region fall into the average category as recommended by the American Heart Association. The pre-

Table 5: Estimated Maximal Oxygen Consumption Mean Values for Officers in the Prairie Region Compared to Correctional Officers (Quebec and Pacific Regions) and Data for the Canadian Population

Age	Officers (Prairie Region)		Correctional Officers (Pacific Region) (38)	Correctional Officers (Quebec Region) (41)	Canadian Population (6)
	Pre-Prog.	Post-Prog.			
18-29 years	n=32	n=32	n=10	n=63	n=88
Estimated MVO_2 (litres per min.)	3.2 ± .5	3.5 ± .6	3.1 ± .5	2.2 ± .5	NDA*
Estimated MVO_2 (ml/kg. per min.)	39.8 ± 6.7	42.7 ± 7.6	34.9 ± 4.4	29.3 ± 6.7	36.9 ± 8.2
30-39 years	n=10	n=10	n=12	n=64	n=148
Estimated MVO_2 (litres per min.)	2.9 ± .6	3.1 ± .7	2.8 ± .6	2.1 ± .6	NDA*
Estimated MVO_2 (ml/kg. per min.)	34.9 ± 8.2	37.7 ± 9.4	31.3 ± 5.7	26.3 ± 6.6	32.9 ± 6.4
40-49 years	n=10	n=9	n=8	n=35	n=76
Estimated MVO_2 (litres per min.)	2.4 ± .3	2.7 ± .3	2.7 ± .4	2.1 ± .7	NDA*
Estimated MVO_2 (ml/kg. per min.)	29.6 ± 5.7	32.6 ± 6.1	27.3 ± 5.2	27.0 ± 8.5	27.2 ± 5.8

* No Data Available

programme 18-29 year age group is the only group to surpass Montpetit's recommended standards. The 30-39 and the 40-49 year age group clearly do not achieve the standards as set down by Montpetit, which accurately reflect the cardio-vascular efficiency requirements necessary to perform correctional duties.

Table 6: Estimated Maximal Oxygen Consumption Values of Officers in the Prairie Region Compared to American Heart Association Recommended Norms and Montpetit's Recommended Standards.

	AGE					
	18-29 years		30-39 years		40-49 years	
Officers (Prairie Region) Mean (ml/kg. per min.)	Pre-Prog.	39.8	Pre-Prog.	34.9	Pre-Prog.	29.6
	Post Prog.	42.7	Post Prog.	37.7	Post Prog.	32.6
American Heart Ass. Recommended Norms-Average Category (6) (ml/kg. per min.)	34 - 42.9		31 - 37.9		27 - 35.9	
Montpetit's Recommended Standards (41) (ml/kg. per min.)	38.0		35.0		31.0	

The pre-programme one-way analysis of variance between groups of officers in the Prairie Region for estimated maximal oxygen consumption (litres per min. and ml/kg. per min.) reveals significance at the .05 level.

3. Grip Strength

Muscular strength, the maximal amount of force that one muscle group can exert over one maximal repetition was measured by the hand-grip dynamometer in this study. The pre-programme grip strength of penitentiary officers in the Prairie Region is located in Table 7.

Table 7: Pre-Programme Mean Grip Strength of Officers in the Prairie Region

	AGE		
	18-29 years	30-39 years	40-49 years
Officers (Prairie Region) Right Hand -kg.	n=32 59.6 ± 9.1	n=10 53.3 ± 6.2	n=10 49.4 ± 7.5
Officers (Prairie Region) Left Hand -kg.	n=32 55.0 ± 7.4	n=10 53.2 ± 6.9	n=10 48.3 ± 8.0
Officers (Prairie Region) Mean Right and Left Hand -kg.	n=32 57.3	n=10 53.2	n=10 48.8

The mean grip strength of the officers tested tended to decrease with age. Appendix A provides normative data for the Canadian population (39).

Table 8 compares mean values for grip strength of officers in the Prairie Region with those of the Pacific Region, Quebec Region, Canadian population, and Montpetit's Recommended Standards. There is a general strength decrement with an age increase in the pre-programme results in the Prairie Region. When the right hand grip strength of Prairie Region officers in the 18-29 year age group (59.6 kg.) is compared to all other groups, the mean value is much higher in this age group. It would appear that the Montpetit standard (47.0 kg.) with the right hand for this age group should be easily attained by an individual officer according to mean values in the Prairie Region. Officers in the 18-29 year age group demonstrated a mean value of 55.0 kg. with the left hand. This value is almost equivalent to the mean value for the right and left hand in the Quebec Region, slightly above the mean value (right and left hand) for Canadians, and slightly below the mean value in the Pacific Region (57.7 kg.) left and right hand. The mean value for the left hand of officers in the Prairie Region is substantially higher than Montpetit's recommended value (47.0 kg.).

In the 30-39 year age group, the mean value of the right hand (53.3 kg.) and the left hand (53.2 kg.) are almost equivalent. Mean values for both the right and left hand surpassed the Canadian norm (52.1 kg.). Montpetit's

Table 8: Pre-Programme Mean Grip Strength of Officers in the Prairie Region Compared to Correctional Officers (Quebec and Pacific Regions), Normal Data on 414 Canadians, and Montpetit's Standards

	AGE					
	18-29 years		30-39 years		40-49 years	
Officers (Prairie Region) - kg.	Right Hand	Left Hand	Right Hand	Left Hand	Right Hand	Left Hand
	n=32	n=32	n=10	n=10	n=10	n=10
	59.6± 9.1	55.0± 7.4	53.3± 6.2	53.2± 6.9	49.4± 7.5	48.3± 8.0
Correctional Officers (Pacific Region) (38) Mean Right and Left Hand -kg.	n=10		n=12		n=8	
	57.7 ± 6.7		51.1 ± 8.1		52.3 ± 5.6	
Correctional Officers (Quebec Region) (41) Mean Right and Left Hand -kg.	n=63		n=64		n=35	
	55.8 ± 8.2		54.7± 8.8		51.7± 5.9	
Canadians Mean Right and Left Hand (39) - kg.	n=129		n=106		n=98	
	54.0 ± 8.6		52.1 ± 8.7		55.2± 10.5	
Montpetit's Standards (41) Right and Left Hand -kg.	47.0		47.0		47.0	

standard (47.0 kg.) was maintained by the 30-39 year age group. In the 40-49 year age group the mean value for the left hand (49.4 kg.) and the right hand (48.3 kg.) surpassed the standard recommended by Montpetit (47.0 kg.) but did not reach the Canadian norm (55.2 kg.). The mean values for this group were also below the Quebec Region (51.7 kg.) and the Pacific Region (52.3 kg.).

The Prairie Region grip strength results indicate that strength decreases with age, and based upon this research, the Prairie Region decreases more than the other two Regions compared in this study. The pre-programme one-way analysis of variance between groups for grip strength of both the right and left hand reveals significance at the .05 level.

4. Flexibility Forward

Flexibility, the functional capacity of the muscles and joints to move through a full range of motion, should be developed in penitentiary officers so that they may follow the normal living activities of working, exercising, and resting without undue muscular strain.

Table 9 indicates the mean scores for the pre-programme flexibility test as compared to the Norms by Age-Group for Trunk Flexion obtained from Health and Welfare Canada (32). Pre-programme mean values in this study for Flexibility Forward for the 18-29 year age group fell into the "Average" category. Pre-programme mean values for the 30-39 year age

group fell into the "Good" category (13.1 - 17.3 inches). The pre-programme mean values for the 40-49 year age group were in the "Below Average" Category (4.3 - 8.6 inches) when compared to Health and Welfare Canada norms.

Table 9: Mean Flexibility Pre-Programme and Post-Programme Values of Officers in the Prairie Region Compared to Health and Welfare Canada Mean Scores "Average" Category for Males

	AGE		
	18-29 years	30-39 years	40-49 years
Pre-Programme Officers - inches	11.7 ± 3.4	13.3 ± 1.6	8.4 ± 3.8
Post-Programme Officers - inches	13.1 ± 3.1	14.4 ± 1.7	9.2 ± 4.4
Health and Welfare Canada (32) "Average" Category - inches	9.8 ± 13.8	9.4 ± 13.0	8.7 ± 12.2

The pre-programme one-way analysis of variance between groups for flexibility forward reveals significance at the .05 level.

Post-Programme Physical Fitness Levels of Penitentiary Officers (Prairie Region)

Raw data from the post-programme physical fitness tests was collected and calculated. Means, standard deviations and a one-way analysis of variance for the between groups variance estimate and the within groups variance estimate were calculated with the aid of a computer. The results of the three levels of age were tabulated and appear in Table 10 and Table 11.

1. Body Size and Composition

The body size, body composition, and range of body size and body composition appear in Table 10. The post-programme mean weight of the officers increased in all age categories at the conclusion of the programme. This may have occurred as a result of the subjects consuming food products prepared by the institution, and consequently, different from their customary diet. Furthermore, the training effects of the course may have increased the lean body weight. The largest mean increase occurred in the 40-49 year age group (4.9 lbs.). The mean percentage of body fat decreased in the 18-29 year age group (0.3) and the 30-39 year age group (0.4). There was a slight mean percentage increase in the 40-49 year age group (0.1). The post-programme mean lean body weight increased substantially in all age categories: 18-29 years (2.6 pounds), 30-39 years (1.5 pounds), and 40-49 years (3.5 pounds).

Table 10: Post-Programme Body Size and Body Composition of Penitentiary Officers in the Prairie Region (Means, Standard Deviations, and Ranges)

	Groups	18-29 years	30-39 years	40-49 years
	Number of Subjects	32	10	10
	Age - years	23.8 ± 2.7	34.5 ± 3.2	42.7 ± 3.1
	Weight - pounds	181.0 ± 23.9 136.0-236.5	184.9 ± 25.8 143.0-223.7	184.7 ± 24.9 145.2-226.6
*	Body Fat - percent	24.4 ± 4.6 14.2 - 31.9	25.2 ± 4.7 18.3 - 35.0	25.5 ± 4.2 18.0 - 29.9
*	Lean Body Weight - pounds	136.1 ± 14.3 114.0-166.3	137.9 ± 18.1 103.1-165.2	136.9 ± 14.1 118.3-161.6
*	Ideal Weight - pounds	153.8 ± 20.3 131.3-201.5	157.1 ± 21.9 124.6-197.3	157.0 ± 21.1 140.8-195.6
*	Excess Weight Over Ideal - pounds	17.7 ± 9.8 -1.4 - 35.4	19.3 ± 10.8 6.1 - 44.8	20.1 ± 9.1 4.4 - 27.9

* Calculated from skinfolds.

The mean excess over ideal weight decreased slightly in the 18-29 year age group (0.3 lbs.) and in the 30-39 year age group (0.7 lbs.). There was a mean increase in the 40-49 year age group (0.7 lbs.).

Table 11: Post-Programme Physical Fitness Levels of Penitentiary Officers in the Prairie Region (Means and Standard Deviations)

	Groups	18-29 years n=32	30-39 years n=10	40-49 years n=10
*	Estimated MVO_2 - litres per min.	3.5 ± .6	3.1 ± .7	n=9 2.7 ± .3
*	Estimated MVO_2 - ml/kg. per min.	42.7 ± 7.6	37.7 ± 9.4	n=9 32.6 ± 6.1
*	Grip Strength Right Hand - kg.	61.6 ± 10.1	58.5 ± 7.9	52.0 ± 9.1
*	Grip Strength Left Hand - kg.	56.4 ± 7.4	56.7 ± 6.8	49.5 ± 10.5
*	Flexibility Forward - inches	13.1 ± 3.1	14.4 ± 1.7	9.2 ± 4.4

* Post-Programme ANOVA Between Groups significant at the .05 level.

2. Estimated Maximal Oxygen Consumption (MVO_2)

The post-programme mean estimated MVO_2 values of officers tested in this study are presented in Table 12. The Åstrand-Ryhming test predicted a mean increase of estimated maximal oxygen consumption in all three age groups in the post-test. One officer in the 40-49 year old age group did not complete the Åstrand-Ryhming test. Consequently, his results were not recorded for the post-programme estimated maximal oxygen consumption, although all other measurements were recorded and utilized in this study.

In terms of litres per minute, the 18-29 year age group mean increased 0.3 litres per min.; the 30-39 year age group mean increased 0.2 litres per min.; and the 40-49 year age group surpassed the pre-test mean by 0.3 litres per min.

Table 12: Estimated Maximal Oxygen Consumption Post-Programme Mean Values for Officers in the Prairie Region

AGE (years)	MVO_2	
	litres per min.	ml/kg. per min.
18-29 n=32	3.5 ± .6	42.7 ± 7.6
30-39 n=10	3.1 ± .7	37.7 ± 9.4
40-49 n=9	2.7 ± .3	32.6 ± 6.1

Maximal oxygen consumption is often expressed in ml/kg. per min. which takes body weight into consideration. All groups increased their mean aerobic capacity as indicated by the following: 18-29 years (2.9 ml/kg. per min.), 30-39 years (2.8 ml/kg. per min.), and 40-49 years (3.0 ml/kg. per min.).

Table 5 indicates the mean MVO_2 post-test scores for officers in the Prairie Region as compared to other populations. All age groups surpassed the Canadian norms (6), correctional officers (Pacific Region), and correctional officers (Quebec Region) by higher values than in the pre-test situation.

Following the six week physical education programme, the officers in the Prairie Region post-test situation increased their mean estimated maximal oxygen consumption level to a point whereby they easily surpassed Montpetit's Recommended Standards (Table 6). The post-programme mean estimated MVO_2 above Montpetit's standards for the three age groups were: 18-29 years (4.7 ml/kg. per min.), 30-39 years (2.7 ml/kg. per min.), and 40-49 years (1.6 ml/kg. per min.).

A post-programme one-way analysis of variance between groups for estimated maximal oxygen consumption revealed significance at the .05 level.

3. Grip Strength

The post-programme mean grip strength results of the penitentiary officers tested in this study are located in Table 13. Post-test means calculated on the right hand of officers show an increase in all age categories: 18-29 years (1.9 kg.), 30-39 years (5.2 kg.), and 40-49 years (2.6 kg.). Post-test means calculated on the officers' left hand grip show an increase in the three age groups: 18-29 years (1.4 kg.), 30-39 years (3.5 kg.), and 40-49 years (1.2 kg.).

Table 13: Post-Programme Mean Grip Strength of Officers in the Prairie Region

OFFICERS (PRAIRIE REGION)	AGE		
	18-29 years	30-39 years	40-49 years
Right Hand - kg.	n=32 61.6 ± 10.1	n=10 58.5 ± 7.9	n=10 52.0 ± 9.1
Left Hand - kg.	n=32 56.4 ± 7.4	n=10 56.7 ± 6.8	n=10 49.5 ± 10.5
Mean Right and Left Hand - kg.	n=32 59.0	n=10 57.6	n=10 50.8

Table 14 compares mean values for grip strength of officers of the Prairie Region with those from the Pacific Region, Quebec Region, Canadian norms, and Montpetit's Recommended Standards for the Canadian Penitentiary Service. The officers' right hand post-test means in the Prairie

Region surpassed the three groups in question in the 18-29 and 30-39 year age categories. In the 40-49 year age category the officers' mean scores in the Prairie Region surpassed those in the Quebec Region, but were slightly below the mean values of the Pacific Region and the Canadian population. The officers' left hand post-test means surpassed the three groups in the 30-39 year age group. Grip strength means of the 18-29 year age group in the Prairie Region for the left hand were slightly higher than the Quebec Region and Canadian population. The 40-49 year age group of Prairie Region officers' mean left hand grip strength was below all three groups being compared.

The Prairie Region officers' means for grip strength surpassed Montpetit's Recommended Standards for Grip Strength (47.0 kg.) for the right hand as follows: 18-29 years (14.6 kg.), 30-39 years (11.5 kg.), and 40-49 years (5.0 kg.). The Prairie Region officers' means for grip strength surpassed Montpetit's Recommended Standards for Grip Strength (47.0 kg.) for the left hand as follows: 18-29 years (9.4 kg.), 30-39 years (9.7 kg.) and 40-49 years (2.5 kg.).

A post-programme one-way analysis of variance between groups for right and left hand grip strength indicates significance at the .05 level.

Table 14: Post-Programme Mean Grip Strength of Officers in the Prairie Region Compared to Correctional Officers (Quebec and Pacific Regions), Normal Data on 414 Canadians, and Montpetit's Standards

	AGE					
	18-29 years		30-39 years		40-49 years	
	Right Hand	Left Hand	Right Hand	Left Hand	Right Hand	Left Hand
Officers (Prairie Region) -kg.	n=32 61.6± 10.1	n=32 56.4± 7.4	n=10 58.5± 7.9	n=10 56.7± 6.8	n=10 52.0± 9.1	n=10 49.5± 10.5
Correctional Officers (Pacific Region) (38) Mean Right and Left Hand -kg.	n=10 57.7 ± 6.7		n=12 51.1 ± 8.1		n=8 52.3 ± 5.6	
Correctional Officers (Quebec Region) (41) Mean Right and Left Hand -kg.	n=63 55.8 ± 8.2		n=64 54.7 ± 8.8		n=35 51.7 ± 5.9	
Canadians (39) Mean Right and Left Hand -kg.	n=129 54.0 ± 8.6		n=106 52.1 ± 8.7		n=98 55.2 ± 10.5	
Montpetit's Standards (41) Right and Left Hand -kg.	47.0		47.0		47.0	

4. Flexibility Forward

Table 9 shows a comparison of flexibility forward for pre- and post-tests for officers in the Prairie Region, as well as the Norms by Age-Groups for Trunk Flexion accepted by Health and Welfare Canada (32). The post-programme mean flexibility forward values for the 18-29 and 40-49 year age groups were in the "Average" Category when compared to these norms. The 30-39 year age group post-programme mean flexibility values were in the Health and Welfare Canada "Good" Category (13.1 - 17.3 inches).

The post-test scores showed an increase in flexibility when compared to pre-test scores in all age groups: 18-29 years (1.4 inches), 30-39 years (1.0 inches), and 40-49 years (0.8 inches). The largest increase occurred in the 18-29 year age category, which is not surprising since this group no doubt had fewer fears with regard to injury during performance on this test.

A post-programme one-way analysis of variance between groups for forward flexibility reveals significance at the .05 level.

Effectiveness of Physical Education in the Induction Security Programme

The mean scores and standard deviations of the various physical fitness measurements of the penitentiary officers for both the pre-test and post-test were computed. These values are evident in Table 15. A one-way Analysis of Variance on Repeated Measures was utilized to determine statistical significance.

The one-way ANOVA on Repeated Measures discovered the following to be significant at the .05 level: Estimated MVO_2 (litres per min.), Estimated MVO_2 (ml/kg. per min.), Grip Strength for the Right and Left Hands, and Flexibility Forward.

Post-Test Results of Physical Fitness Mean Values for Penitentiary Officers Compared With Montpetit's Recommended Standards

1. Skinfold Measures

Montpetit recommended that a correctional officer should have less than 45 mm. of fat distributed over four sites of his body (triceps, biceps, subscapular, and supra-iliac). The excess over ideal weight would thus be approximately ten pounds. Individual results from the post-test data reveal that seven of the fifty-two officers (13.5%) tested met Montpetit's Recommended Standard, and

Table 15: Pre-Test and Post-Test Body Size and Physical Fitness Mean Values of Penitentiary Officers in the Prairie Region

	Pre-Test n=52	Post-Test n=52
Age - years	29.4 ± 8.2	29.5 ± 8.2
Height - inches	70.1 ± 2.5	No Data Available
Weight - pounds	179.6 ± 25.1	182.4 ± 24.0
Body Fat - percentage	25.0 ± 4.5	24.8 ± 4.5
Lean Body Weight - pounds	134.1 ± 15.4	136.6 ± 14.8
Ideal Weight - pounds	152.7 ± 21.3	155.1 ± 20.4
Excess Over Ideal Weight - pounds	18.6 ± 9.8	18.5 ± 9.7
* Estimated MVO_2 -litres per min.	3.0 ± .6	n=51 3.3 ± .7
* Estimated MVO_2 -ml/kg. per min.	36.9 ± 7.9	n=51 39.9 ± 8.6
* Grip Strength Right Hand -kg.	56.4 ± 9.2	59.1 ± 10.1
* Grip Strength Left Hand -kg.	53.4 ± 7.7	55.2 ± 8.3
* Flexibility Forward - inches	11.4 ± 3.5	12.6 ± 3.6

* One Way ANOVA on Repeated Measures statistically determined to be significant at the .05 level.

were less than ten pounds overweight. Conversely, forty-five officers (86.5%) were, in varying degrees, overweight.

2. Estimated Maximal Oxygen Consumption (MVO_2)

Montpetit recommended that 18-29 year old officers must achieve a maximal oxygen consumption score of at least 38 ml/kg. per min., those 30-39 years of age - 35 ml/kg. per min., and 40-49 years old - 31 ml/kg. per min. The data from individual results after a six week physical education course revealed that thirty-four out of fifty-one officers (66.7%) in the Prairie Region met the required standards for cardiovascular efficiency.

3. Grip Strength

The recommended standards require that the officer exert at least 47.0 kilograms grip strength with each hand. Individual results indicate that forty-two out of fifty-two officers (80.8%) have the strength capability to meet this criterion.

SUMMARY AND CONCLUSIONS

Many physiological and medical studies indicate the beneficial effect of regular physical training. Individuals in top physical condition will be able to fulfill tasks involving physical work more effectively and with less effort than a person in poor physical condition.

Cardiovascular efficiency, the most meaningful evaluation of physical fitness, must be measured in every fitness programme. The post-programme measurement of penitentiary officers in the Prairie Region reveal that 66.7 percent of the officers tested met the cardiovascular efficiency criterion suggested by Montpetit. Individual pre-programme results reveal that twenty-six of fifty-two officers (50.0%) met the Montpetit Standard. This tends to suggest that additional training is needed over an extended period of time in order to allow a higher percentage of officers an opportunity to reach the Recommended Standard.

Another alternative is to establish a cardiovascular efficiency criterion for selection of penitentiary officers. Utilizing the knowledge of the mean increase in oxygen consumption as a result of the physical education course at the Staff College (Edmonton), the following Minimal Estimated Maximal Oxygen Consumption Selection Standards may be recommended for implementation during the hiring process as a prerequisite to the Induction Security Training

Programme: 18-29 years (35 ml/kg. per min.), 30-39 years (32 ml/kg. per min.), and 40-49 years (28 ml/kg. per min.). This study has indicated that approximately a 3 ml/kg. per minute increase in estimated maximal oxygen consumption, for all three age groups, resulted from the six-week physical education programme. Therefore, Montpetit's standards for estimated maximal oxygen consumption have been lowered prior to training. Montpetit recommended that the correctional officer must reach a certain level of fitness in order to work effectively in an institutional setting. Montpetit's maximal oxygen consumption standards are as follows: 20-29 years (38 ml/kg. per min.), 30-39 years (35 ml/kg. per min.), and 40-49 years (31 ml/kg. per min.).

When the Minimal Estimated Maximal Oxygen Consumption Selection Standards are upheld, it can be expected that most officers will reach Montpetit's Recommended Standards for maximal oxygen consumption, and consequently cardiovascular efficiency, upon conclusion of the physical education course.

As a result of this study, it is recommended that cardiovascular fitness testing must be administered during the hiring process, and the Minimal Estimated Maximal Oxygen Consumption Selection Standards be implemented. Canadian Corrections Service policy states that officers must complete Induction Security Training prior to institutional work. Consequently, officers have ample opportunity during training to reach the estimated maximal oxygen consumption

recommended by Montpetit, even though they may be somewhat below that level during the initial hiring process.

It is recommended that a laboratory test of cardiovascular efficiency, such as the Åstrand Submaximal Bicycle Test be utilized as the tool of measurement during the selection process of correctional officers. Additional study may indicate that a field test, like Cooper's 12-Minute Run-Walk Test (15) be administered to predict maximal oxygen consumption. Nevertheless, a method of measurement of maximal oxygen consumption is mandatory for the evaluation and consequent selection of future employees in the Canadian Corrections Service. Thus, the Service can be assured that these prospective employees meet the physical fitness job requirements at the time of measurement, or that they have the capability of obtaining the necessary fitness standards in a relatively short period of time.

Body composition is also an important factor in determining the physical fitness of an individual. Only 13.5 percent of the officers tested met Montpetit's Recommended Standard with regard to body composition. There appears to be some inconsistency in this research when the relatively high mean oxygen consumption values are compared to body composition (high mean values of percentage of fat and excess weight). This may be due to unreliable skinfold measurements because the officers in this study, generally speaking, were large men. It was difficult at times to

differentiate between muscle tissue and adipose tissue on account of the anatomical size of many of the men.

Muscular strength is an important component of physical fitness, but is highly dependant upon motivation factors. This research shows that 80.8 percent of the officers tested after training met Montpetit's Recommended Standard. Prior to training, 73.1 percent of the officers tested met the standard. The criterion set by Montpetit for grip strength is therefore suitable for this population.

Mean flexibility scores indicate that the average penitentiary officer can achieve at least "average" classification following the Induction Security Course.

Montpetit has recommended minimum standards of fitness for correctional officers. Based upon this research, these standards are definitely realistic in terms of oxygen consumption and grip strength. Therefore, it is recommended that physical fitness criteria, namely grip strength and cardiovascular efficiency be utilized in the selection process of correctional officers.

This study has shown that the majority of newly recruited officers improve their level of physical fitness in a relatively short period of time to the extent that they were beyond the standards set down by Montpetit. In order for this level of physical fitness to be maintained, programmes and facilities must be offered by the Canadian Corrections Service. Follow-up medical examinations and

physical fitness testing must take place annually to ensure that these standards are upheld.

A trained physical educator must be hired to administer the annual testing procedures, tabulate results, and make recommendations to the institutional supervisors. The fitness evaluation should not be utilized in a negative sense, but positively, as an incentive for purposes of advancement and job mobility. When individuals do not reach the recommended standards, a suitable time limit should be provided before the re-test situation. The physical educator may also be responsible for the organization and implementation of physical fitness, sports, and recreational programmes for all institutional employees. This physical education programme may be community-based where many of the existing athletic facilities in the surrounding areas of the institution are utilized, but each institution should have employee access to a central athletic facility, such as a gymnasium, running facility, and shower facilities.

Each institutional employee must be encouraged to take part in this non-compulsory programme which will provide opportunities for interaction with individuals and groups in the community.

The maintenance of the physical fitness of every officer must be considered important by both management and the employee. It is recommended that further study be devoted to the assurance that physical fitness of officers

be maintained at the institutional level.

It is strongly recommended that a physical fitness testing protocol, such as that used in this study, be utilized in the Canadian Corrections Service (Prairie Region), as well as nation-wide in the Canadian Corrections Service to ensure stability and continuity in performance of officers in the required work tasks.

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APPENDIX A

C.A.H.P.E.R. Grip Strength Normative Data For Canadian Males Aged 20-44 Years

APPENDIX A

C.A.H.P.E.R. Grip Strength Normative Data For Canadian Males Aged 20 - 44 Years (39)

20-24 years		25-34 years		35-44 years		
Grip Strength (kilograms)		Grip Strength (kilograms)		Grip Strength (kilograms)		
Right Hand	Left Hand	Right Hand	Left Hand	Right Hand	Left Hand	Percentile
72	75	80	83	78	82	100
67	63	69	70	69	68	95
65	61	68	67	65	62	90
63	59	66	63	64	60	85
61	58	64	60	62	59	80
60	56	62	59	59	58	75
58	55	61	57	58	56	70
56	54	60	56	57	56	65
55	53	59	56	56	55	60
54	52	58	55	55	54	55
54	51	57	54	53	52	50
53	50	56	53	53	52	45
51	49	55	51	52	50	40
50	48	54	50	50	49	35
49	47	52	49	49	47	30
48	45	50	48	48	45	25
45	44	48	46	47	44	20
43	43	47	45	46	41	15
43	39	45	43	44	39	10
40	38	41	37	40	36	5

APPENDIX B

Example of Metabolic Analysis of Typical Day of a Correctional Officer

APPENDIX B

Example of Metabolic Analysis of Typical Day of a Correctional Officer (41)

ACTIVITY	DURATION OF ACTIVITY PER DAY (MIN.)	AVERAGE HEART RATE (PER MIN.)	GROSS ENERGY EXPENDITURE (KCAL/MIN.)	TOTAL ENERGY EXPENDED (PER 8 HOUR-WORK PERIOD)
SITTING AT WORK	208	79.4	1.6	332.8
STANDING AT WORK	92	87.2	2.0	184.0
CLIMBING STAIRS	4	112	6.5	26.0
WALKING	88	110.5	4.9	352.0
EATING	29	83.3	1.8	52.2
DRINKING COFFEE	4	85.4	1.9	7.6
TALKING OR PLAYING CARDS	39	92.4	2.2	85.8
OTHER ACTIVITIES	16	95.6	4.0	64.0
	480			1104.4
ESTIMATED ENERGY EXPENDITURE OUTSIDE OF WORK	960			1630
TOTAL	1440			2734.4